Study on the Utilization of *Moringa Oleifera* (Danda-lun) Leaves as Valuable Ingredient in Food Products

Aye Aye Mar

Abstract

Moringa oleifera leaves contain a rich source of vitamins and minerals and exhibits strong antioxidant activity. The present research work, *Moringa oleifera* leaves were selected as valuable ingredient in the preparation of food products. Association of Official Analytical Chemists (AOAC) method was used for determination of the properties and nutritional value of fresh *Moringa oleifera* leaves.The phytochemical screening of crude extract of *Moringa oleifera* leaves was conducted which gave positive test for polyphenols, flavonoids, glycosides, tannins and steroid.The powder of *Moringa oleifera* leaves was prepared using shade drying and subsequent grinding. Elemental compositions of the powder of *Moringa oleifera* leaves were investigated by Energy Dispersive X-Ray Fluorescence (EDXRF) method, which gave high concentration of calcium and potassium. The food products such as Moringa leaf enriched cookies, cupcakes and tablets were prepared using the powder and extract of Moringa *oleifera* leaves. The effects of various ingredients on the quality of prepared Moringa leaf enriched food products were investigated. The physico-chemical properties and nutritional values of processed Moringa leaf enriched food products were analyzed and also compared with commercial products. Moreover, microbiological analysis and heavy metals such as arsenic, mercury, lead, zinc and cadmium of processed Moringa leaf enriched food products were also determined.

Key words: *Moringa oleifera* leaves, nutritional values, phytochemical, elemental compositions

Introduction

Moringa oleifera (Danda-lun) is a multipurpose and exceptionally nutritious vegetable tree with a variety of potential uses. Its leaves are extremely valuable source of nutrition for people of all ages. It has very high nutritional properties that would be useful as a food supplement, especially in those relegated communities. Besides its nutritional and medicinal applications, M. oleifera is very useful as an alley crop in the agro-forestry industry (Mishra, S.P., 2012). *Moringa oleifera* is one of the promising plants which could contribute to increase intake of some essential nutrients and health-promoting phytochemicals. The leaves are outstanding as a source of vitamins, plant sources of minerals and source of protein with low sources of fat and carbohydrates. Nutritional analysis indicates that *Moringa oleifera* leaves contain affluence of essential, disease preventing nutrients (Madukwe, E.U., *et al*, 2013).

Among the bakery products, cookies are most significant in the world. Cookies differ from other baked products because of their low moisture content which ensures that they are free from microbial spoilage and confer a long shelf-life on the product (www.ijesi.org). A cupcake is a small cake designed to serve one person, which may be baked in a small thin paper or aluminium cup (http://en.wikipedia. org/wiki/Cupcake).

A tablet is a pharmaceutical dosage form. It comprises a mixture of active substances and excipients, usually in powder form, pressed or compacted from a powder into a solid dose (http*://e*n.wikipedia.org/ wiki/ tablet).

The aim of this research work is to investigate the suitable processing method for the preparation food products from *Moringa oleifera* leaves and their evaluation. The specific objectives of this research work are to study the physico-chemical and nutritional values of *Moringa oleifera* leaves and to prepare the Moringa leaf enriched cookies, cupcakes and tablets that retain higher concentrations of nutrients.

Professor and Head, Dr., Department of Industrial Chemistry, University of Mandalay

Materials and Methods

Materials

In this research work, *Moringa oleifera* leaves were collected from Kyauktan Township, Yangon Region. Flour, icing sugar, vanilla extract, corn oil, baking powder, baking soda, tapioca starch, egg, salt, evaporated milk, milk and butter were used in the preparation of food products. 95% ethanol, ferric chloride, potassium ferrocyanide, 95% sulphuric acid, sodium chloride, chloroform and Benedict's solution (commercial grade, British Drug House Co. Ltd., England) were also used for phytochemical tests.

Methods

Preliminary Preparation of Fresh *Moringa oleifera* Leaves

The fresh *Moringa oleifera* leaves were washed with clean water to remove impurities and washed again with 1% salt solution for 5 minutes to remove microbes. After that, the leaves were washed again with clean water and filter for 15 minutes and stored. The clean leaves were spread it in a single layer on aluminum foils in a well-ventilated room at ambient temperature (32-35°C) for 4 days and weighed. Then they were ground, sieved using the screen of20, 40, 60 and 100 mesh size and stored at room temperature for further work.

Physico-chemical Characteristics of Fresh *Moringa oleifera* Leaves

The characteristics such as moisture content, ash content, protein content, crude fibre content, crude fat content, carbohydrate and energy value of fresh *Moringa oleifera* leaves were determined by Association of Official Analytical Chemists (AOAC) method.

Phytochemical Screening of Fresh *Moringa oleifera* Leaves

The main compounds which are commonly found in fresh *Moringa oleifera* leaves are polyphenols, flavonoids, glycosides, tannins and steroid. Phytochemical screening of fresh *Moringa oleifera* leaves were performed according to the methods and procedures expressed in the Phytochemical Bulletin of Botanical Society of America.

Elemental Compositions of Moringa Leaf Powder

The elemental compositions such as calcium, potassium, sulphur, phosphorus, chlorine, iron, strontium, rubidium, zinc, bromine and copper of Moringa leaf powder (-60+100 mesh size) were determined by Energy Dispersive X-Ray Fluorescence (EDXRF) Spectroscopy (EDX 720).

Preparation of Moringa Leaf Enriched Cookies

Firstly, 25 g of icing sugar, 40 g of butter and 0.5 g of salt were thoroughly mixed by using electric mixer (Phillip, made in China) for 2 minutes. Then, 1.5 g of Moringa leaf powder, 0.5 g baking soda, 65 g of flour, 0.4 g of vanilla and 10 g of evaporated milk were added to the above mixture. After that, they were mixed again by using electric mixer for 5 minutes to obtain the dough. The dough was molded by using cookie molds and baked at 170 °C for 20 minutes in oven to obtain the Moringa leaf enriched cookies.

Effect of Ingredients (Butter and Moringa Leaf Powder) on the Properties of Prepared Moringa Leaf Enriched Cookies

In the preparation of Moringa leaf enriched cookies, various amounts of butter ranging from 40 g to 60 g with fixed amounts of other ingredients and various amounts of Moringa leaf powder ranging from 0.5 g to 2.5 g with fixed amounts of other ingredients were used. The texture and flavour of prepared Moringa leaf enriched cookies were tested with organoleptic properties.

Preparation of Moringa Leaf Enriched Cupcakes

Firstly, 25 g of icing sugar, 5 g of butter and 0.5 g of salt were thoroughly mixed by using electric mixer (Phillip, made in China) for 2 minutes. Then, 15 g of Moringa leaf extract, 1 g of baking powder and baking soda, 30 g of flour, 0.2 g of vanilla extract, 7 g of milk, 15 g of egg and 30 g of corn oil were added to mixture. After that, they were mixed again by using electric mixer for 5 minutes. Finally, the above mixture were filled into the cups and baked at 180 °C for 25 minutes in an oven to obtain Moringa leaf enriched cupcakes.

Effect of Ingredients (Butter and Moringa Leaf Extract) on the Properties of Prepared Moringa Leaf Enriched Cupcakes

In the preparation of Moringa leaf enriched cupcakes, various amounts of butter ranging from 5 g to 25 g with fixed amounts of other ingredients and also various amounts of Moringa leaf extract ranging from 5 g to 25 g with fixed amounts of other ingredients were used respectively. The texture, flavour and colour of prepared Moringa leaf enriched cupcakes were tested with organoleptic properties.

Preparation of Moringa Leaf Tablets

Firstly, 4 g of tapioca starch as binder and 5 ml of warm water were put in a stainless steel container and stirred for 10 minutes with steel spoon. Then, 20 g of Moringa leaf powder (-60+100 mesh size) were added into the mixture and mixing was continued until thorough mixing. The mixture was placed into the cylindrical shaped mould and pressed firmly with make-shift press. After that, they were dried at room temperature (32-35°C) for 12 hours to obtain the Moringa leaf tablets.

Effect of Ingredients (Binder and Moringa Leaf Powder) on the Properties of Prepared Moringa Leaf Tablets

The effect of amount tapioca starch (binder) on the properties of prepared Moringa leaf tablets were determined using various amounts of tapioca starch ranging from 4 g to 20 g based on the 20 g of Moringa leaf powder (-40+60 mesh size).The effect of particle size of Morigna leaf powder on the properties of prepared Moringa leaf tablets was determined using various mesh sizes, ranging from -20+40 mesh size to -60+100 mesh size of 20 g of Moringa leaf powder with 12 g of tapioca starch.

Determination of the Properties of Prepared Moringa Leaf Tablets

The properties of prepared Moringa leaf tablets were determined by using drop test (ASTM. D 440-49) and porosity test.

Drop Test

2 g of prepared Moringa leaf tablets (10 tablets) were put into a standard size plastic bag and sealed tightly with a rubber ring. The Drop test was performed by releasing the prepared Moringa leaf tablets in the plastic bag from a height of 6 ft onto a concrete floor. The dropping was done two times. The size stability and friability of prepared Moringa leaf tablets after Drop test were calculated as follows and the results are recorded.

$$\text{Size stability (\%w/w)} = \frac{\text{Mass of stable lumps of tablets}}{\text{Mass of original tablets}} \times 100$$

$$\text{Friability (\%w/w)} = \frac{\text{Mass of friable lumps of tablets}}{\text{Mass of original tablets}} \times 100$$

Porosity Test

2 g of prepared Moringa leaf tablets (10 tablets) was immersed into the 25 ml of water containing the beaker at room temperature for 10 minutes. After that, water absorbed Moringa leaf tablets were filtered and weighed. The porosity of prepared Moringa leaf tablets was calculated as follows and the results are recorded.

$$\text{Porosity (g/g)} = \frac{\text{Mass of sample immersed in water}}{\text{Mass of water absorbed}}$$

Properties of Moringa Leaf Enriched Cookies, Cupcakes and Moringa Leaf Tablets

The properties and nutritional values such as moisture content, ash content, protein content, crude fibre content, crude fat, carbohydrate and energy value of prepared Moringa leaf enriched cookies, cupcakes and Moringa leaf tablets were determined by Association of Official Analytical Chemists (AOAC) method.

Results and Discussion

The physico-chemical properties and nutritional values of fresh *Moringa oleifera* leaves were determined and the results are shown in Table (1). From the results in Table (1), it can be seen that the moisture content 72.25 %w/w, ash content 12.95 %w/w, protein 8.55 %w/w, crude fiber content 2.37 %w/w, crude fat 1.20 %w/w and carbohydrate 13.68 %w/w and energy value 89 Kcal/100g in fresh *Moringa oleifera* leaves. According to the results in Table (2), it was found that polyphenols, flavonoids, glycosides, tannins and steroid are present in fresh *Moringa oleifera* leaves. Elemental compositions of Moring leaf powder were determined by Energy Dispersive X-Ray Fluorescence (EDXRF) method and the results are shown in Table (3).

The effects of amount of butter and Moringa leaf powder on the properties of prepared Moringa leaf enriched cookies were determined. From the results in Tables (4) and (5), it can be seen that (50) g of butter and (1.5) g of Moringa leaf powder gave the soft texture, light sweet flavour, pleasant smell and bright green colour of prepared Moringa leaf enriched cookies.

In the preparation of Moringa leaf enriched cupcakes, the most suitable amounts such as (15) g of butter and (15) g of Moringa leaf extract gave the smooth texture, pleasant smell, sweet flavour and green colour of prepared Moringa leaf enriched cupcakes as shown in Tables (6) and (7) respectively.

In the preparation of Moringa leaf tablets, higher amount of binder contributed to the harder Moringa leaf tablets as shown in Table (8). (12) g of tapioca starch as binder was chosen as suitable amount for the preparation of Moringa leaf tablets. The quality of prepared Moringa leaf tablets with various mesh size fractions are shown in Table (9). The size stability and friability of prepared Moringa leaf tablets with -40+60 mesh size fraction were better than that of tablets prepared with other mesh size fractions of Moringa leaf power.

The nutritional values, heavy metal and microorganisms of processed Moringa leaf enriched cookies, cupcakes and Moringa leaf tablets are shown in Tables (10) and (11) respectively. From the results in Tables (10) and (11), it can be seen that Moringa oleifera leaves should be used nutrient supplement in foods to improve the nutritional status of people both in terms of micronutrient nutrition and weight gain.

Table (1) Properties and Nutritional Values of Fresh *Moringa oleifera* Leaves

Sr. No.	Characteristics	Experimental Value*	Literature Value **
1	Moisture content, (% w/w)	72.25	75.0
2	Ash content, (%w/w)	1.95	2.12
3	Protein content, (%w/w)	8.55	9.4
4	Crude fiber, (%w/w)	2.37	2.0
5	Crude fat, (%w/w)	1.20	1.4
6	Carbohydrate, (%w/w)	13.68	8.28
7	Energy value, (Kcal/ 100g)	89.0	64.0

* These data were determined at Laboratory of Food Industries Department Supporting Laboratory (FIDSL), Minye Kyawswar Road, Lanmadaw Township, Yangon Region.

** (http://en.wikipedia.org/wiki/Moringa)

Table (2) Phytochemical Properties of Fresh *Moringa oleifera* Leaves

Sr. No.	Tests	Solvent	Reagents	Observation	Inference
1	Polyphenols	EtOH	1%$FeCl_3$ + 1%$K_3\{Fe(CN)_6\}$	Greenish blue colour	+
2	Flavonoids	EtOH	H_2SO_4(conc:) + Mg turning	Pink colour	+
3	Glycosides	H_2O	10% $FeCl_3$	Purple colour	+
4	Tannins	H_2O	2%NaCl+1% $FeCl_3$	Deep blue ppt	+
5	Steroid	H_2O	1% H_2SO_4+1% $CHCl_3$	Reddish blue	+
6	Phenolics	H_2O	10% $FeCl_3$	-	-

Note: + = Present, - = Absent

Table (3) Elemental Compositions of Moringa Leaf Powder

Sr. No.	Elements	Experimental Value* (%w/w)	Literature Value** (%w/w)
1	Calcium (Ca)	41.689	28.8-192
2	Potassium (K)	40.016	42-138
3	Sulphur (S)	9.700	-
4	Phosphorus (P)	3.645	4.9-26.7
5	Chlorine (Cl)	3.310	-
6	Iron (Fe)	0.984	0.6-2.8
7	Stronitum (Sr)	0.188	-
8	Rubidium (Rb)	0.172	-
9	Zinc (Zn)	0.139	0.06-0.25
10	Bromine (Br)	0.083	-
11	Copper (Cu)	0.074	0.02-0.1

* These data were determined by using EDXRF Spectroscopy (EDX 720) at Universities Research Centre, University of Yangon

** (http://en.wikipedia.org/wiki/*Moringa oleifera*)

Table (4) Effect of Amount of Butter on the Properties of Prepared Moringa Leaf Enriched Cookies

Weight of mixture before baking = 142- 162 g
Baking condition = 170°C for 20 minutes
Weight of cookies = 150 g / 20 cookies, (7.5 g / cookie)

Sr. No.	Sample No.	Ingredients								Organoleptic Properties (Texture)
		F (g)	IS (g)	B (g)	BS (g)	EM (g)	MLP (g)	VE (g)	S (g)	
1	I	65	25	40	0.5	10	1.5	0.4	0.5	Firm
2	II	65	25	45	0.5	10	1.5	0.4	0.5	Firm
3	III	65	25	50*	0.5	10	1.5	0.4	0.5	Soft
4	IV	65	25	55	0.5	10	1.5	0.4	0.5	Sticky
5	V	65	25	60	0.5	10	1.5	0.4	0.5	Oily

* Suitable amount of butter

Note: F = Flour
IS = Icing Sugar
B = Butter
BS = Baking Soda
EM = Evaporated Milk
MLP = Moringa Leaf Powder
VE = Vanilla Extract
S = Salt

Table (5) Effect of Amount of Moringa Leaf Powder on the Properties of Prepared Moringa Leaf Enriched Cookies

Weight of mixture before baking = 148- 158 g
Baking condition = 170°C for 20 minutes
Weight of cookies = 150 g / 20 cookies, (7.5 g / cookie)

Sr. No.	Sample No.	Ingredients								Organoleptic Properties (Flavour)
		F (g)	IS (g)	B (g)	BS (g)	EM (g)	MLP (g)	VE (g)	S (g)	
1	I	65	25	50	0.5	10	0.5	0.4	0.5	Present smell, light sweet, light colour
2	II	65	25	50	0.5	10	1.0	0.4	0.5	Present smell, light sweet, slightly brighter colour
3	III	65	25	50	0.5	10	1.5*	0.4	0.5	Present smell, light sweet, bright green colour
4	IV	65	25	50	0.5	10	2.0	0.4	0.5	Bad odour, light sweet, slightly darker colour
5	V	65	25	50	0.5	10	2.5	0.4	0.5	Bad odour, light sweet, slightly darker colour

*Suitable amount of moringa leaf powder

Note: F = Flour
IS = Icing Sugar
B = Butter
BS = Baking Soda
EM = Evaporated Milk
MLP = Moringa Leaf Powder
VE = Vanilla Extract
S = Salt

Table (6) Effect of Amount of Butter on the Properties of Prepared Moringa Leaf Enriched Cupcakes

Weight of mixture before baking = 119- 139 g
Baking condition = 180°C for 25 minutes
Weight of cookies = 45 g / 3 cupcakes, (15 g / cupcake)
Baking power & baking soda = 1g, Milk = 7 g

Sr. No.	Sample No.	Ingredients								Organoleptic Properties (Texture)
		F (g)	IS (g)	B (g)	E (g)	CO (g)	MLE (g)	VE (g)	S (g)	
1	I	30	25	5	15	30	15	0.2	0.5	Slightly tough
2	II	30	25	10	15	30	15	0.2	0.5	Slightly tough
3	III	30	25	15*	15	30	15	0.2	0.5	Smooth
4	IV	30	25	20	15	30	15	0.2	0.5	Oily
5	V	30	25	25	15	30	15	0.2	0.5	Oily

*Suitable amount of butter

Note: F = Flour
IS = Icing Sugar
B = Butter
E = Egg
CO = Corn Oil
MLE = Moringa Leaf Extract
VE = Vanilla Extract
S = Salt

Table (7) Effect of Amount of Moringa Leaf Extract on the Properties of Prepared Moringa Leaf Enriched Cupcakes

Weight of mixture before baking = 129- 149 g Baking condition = 180°C for 25 minutes
Weight of cookies = 45 g / 3 cupcakes, (15 g / cupcake)
Baking power & baking soda = 1g, Milk = 7 g

Sr. No.	Sample No.	Ingredients								Organoleptic Properties (flavour & colour)
		F (g)	IS (g)	B (g)	E (g)	CO (g)	MLE (g)	VE (g)	S (g)	
1	I	30	25	15	15	30	5	0.2	0.5	Present smell and taste, light green colour
2	II	30	25	15	15	30	10	0.2	0.5	Present smell and taste, light green colour
3	III	30	25	15	15	30	15*	0.2	0.5	Present smell and taste, green colour
4	IV	30	25	15	15	30	20	0.2	0.5	Bad odour and taste, dark green colour
5	V	30	25	15	15	30	25	0.2	0.5	Bad odour and taste, dark green colour

*Suitable amount of moringa leaf extract

Table (8) Effect of Amount of Tapioca Starch as Binder on the Physical Properties of Prepared Moringa Leaf Tablets

Drying time and temperature = (32 – 35) °C for 12 hours
Weight of tablets = 32g / 160 tablets, (0.2 g / tablet)

Sample No.	Moringa Leaf Powder		Tapioca Starch (g)	Warm Water (ml)	Physical Properties		
	(g)	(mesh)			Size Stability (%w/w)	Friability (%w/w)	Porosity (g/g)
1	20	-20+40	4	5	65.55	34.45	0.35
2	20	-20+40	8	5	67.68	32.32	0.31
3	20	-20+40	12*	5	70.85	29.15	0.26
4	20	-20+40	16	5	70.87	29.13	0.25
5	20	-20+40	20	5	70.90	29.10	0.25

*Suitable amount of tapioca starch

Table (9) Physical Properties of Prepared Moringa Leaf Tablets using Various Particle Size Moringa Leaf Powder

Drying temperature and time = (32 – 35) °C for 12 hours
Weight of tablet = 32g / 160 tablets, (0.2 g / tablet)

Sample No.	Moringa Leaf Powder		Tapioca Starch (g)	Warm Water (ml)	Physical Properties		
	(g)	(mesh)			Size Stability (%w/w)	Friability (%w/w)	Porosity (g/g)
1	20	-20+40	12	5	70.85	29.15	0.26
2	20	-40+60*	12	5	80.72	19.28	0.23
3	20	-60+100	12	5	80.75	19.25	0.26

*Suitable particle size

Table (10) The Nutritional Value of Processed Moringa Leaf Enriched Products

Sr. No.	Properties	Moringa Leaf Enriched		Moringa Leaf Tablets
		Cookies	Cupcakes	
1	Moisture content, (%w/w)	1.74	20.35	7.621
2	Ash content, (%w/w)	1.04	1.08	3.94
3	Protein content, (%w/w)	6.68	5.60	2.33
4	Crude fiber, (%w/w)	-	-	6.94
5	Crude fat, (%w/w)	25.81	34.45	2.13
6	Carbohydrate, (%w/w)	64.73	38.52	77.04
7	Energy value, (Kcal/100g)	522	486	336.65

These data were determined at Food Industries Development Supporting Laboratory (FIDSL), Minye Kyawswar Road, Lanmadaw Township, Yangon Region.

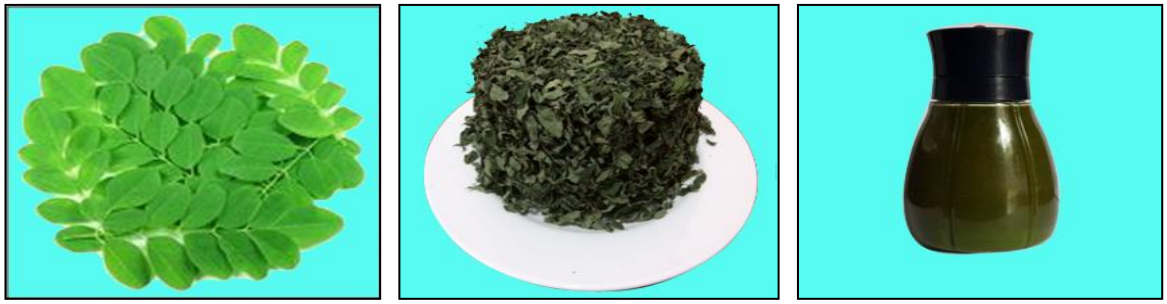
Table (11) Heavy Metal Compositions and Microorganism of Processed Moringa Leaf Enriched Products

Sr. No.	Heavy Metals and Microorganisms	Moringa Leaf Products (ppm)			International Food Standard*** (ppm)
		Cookies	Cupcakes	Tablets	
1	Arsenic, (As)*	ND	ND	ND	1.4
2	Mercury, (Hg) *	ND	ND	ND	0.5
3	Lead, (Pb) *	ND	ND	ND	6.0
4	Zinc, (Zn) *	ND	ND	ND	-
5	Cadmium, (Cd) *	0.003	0.004	0.001	0.1
6	Coliform, (cfu/g)**	Negative	Negative	Negative	-
7	Yeast and Mold, (cfu/g)**	0	0	0	-

Note: ND = not detected, *** (http://eur-lex.europa.)

* Heavy metals of prepared products after 2 month were determined by AAS spectrophotometer at Laboratory of the Department of Applied Geology, Department of Higher Education,Yangon Region.

** Microorganism of the prepared products were determined at Laboratory of Small Scale Industries Department, Ministry of Co-operative, North Okkalapa, Yangon Region.



(b) Fresh Leaves (b) Dried Leaves (c) Leaves Extract

Figure (1) *Moringa oleifera* Leaves

(a) Cookies (b) Cupcakes (c) Tablets

Figure (2) Moringa Leaf Enriched Products

Conclusions

The Moringa leaves could be utilized as a valuable food ingredient to prepare a wide range of food products considering its valuable nutrient composition with noticeable amount of both macronutrients (carbohydrate, protein) and micronutrients (minerals, antioxidants).

The most favourable composition of the processed Moringa leaf enriched cookies were 50 g of butter, 25 g of icing sugar, 1.5 g of Moringa leaf powder, 65 g of flour, 0.5 g baking soda, 10 g evaporated milk, 0.4 g of vanilla extract and 0.5 g of salt.

The most favourable composition of the processed Moringa leaf enriched cupcakes were 15 g butter, 25 g icing sugar, 15 g Moringa leaf extract, 30 g flour, 15 g of egg, 30 g of corn oil, 0.2 g of vanilla extract, 0.5 of salt, 7 g of milk, 1 g of baking powder and baking soda.

The most favourable composition of the processed Moringa leaf tablets were 20 g Moringa leaf powder (-40+60 mesh size) with 12 g of tapioca starch (binder) and 5 ml of warm water.

Acknowledgements

The author thanks Dr Thida Win, Rector, University of Mandalay, Dr Tin Tun Aung, Dr Myin Zu Minn and Dr Min Min Yee, Pro-rectors, University of Mandalay for their kind permission to submit this article.

References

Gyamfi, E.T., *et al*, (2011). "Effects of Processing on *Moringa oleifera*", *Proceedings of the International Academy of Ecology and Environmental Sciences*, 1(3-4):179-185.

Mensah, J.K, *et al*, (2012). *Phytochemical, Nutritional and Antibacterial Properties of Dried Leaf Powder of Moringa Oleifera from Edo Central Province*, Nigeria, Scholars Research Library, J. Nat. Prod. Plant Resour., 2(1):107-112.

Mishra, S.P., (2012). *Processing of Moringa oleifera Leaves for Human Consumption*, Bulletin of Environment, Pharmacology and Life Sciences, Vol.2 [1], pg 28-31, India.

Madukwe , E.U., *et al*, (2013). "Nutrient Composition and Sensory Evaluation of Dry Moringa Oleifera Aqueous Extract", *International Journal of Basic & Applied Sciences* IJBAS-IJENS Vol. 13 No:03.

Offer, I.F, *et al*, (2014). "Proximate Nutrional Analysis and Heavy Metal Composition of Dried *Moringa oleifera* Leaves from Oshiri Onicha L.G.A", *IOSR Journal of Environmental Science Toxicology and Food Technology (IOSR-JESTFT)*, Volume 8, Issue I Ver I, PP 57-62.

Pearson, D. **(**1976). *The Chemical Analysis of Food*, Churchill Livingstone, 7th Edition, London and New York.

Singh.Y and K. Prasad , (2013)."*Moringa oleifera* Leaf as Functional Food Powder: Characterization and Uses", *International Journal of Agriculture and Food Science Technology*, ISSN 2249-3050, Vol 4, No. 4, pp.317-324©, Research India Publications.

Websites

http://articles.mercola.com/herbal-oils/corn-oil.aspx

http://en.wikipedia .org/wiki/Cupcake

http://en.wikipedia.org/ wiki/*Moringa oleifera*

http://en.wikipedia .org/wiki/Tablet

www.ijesi.org

www.iosrjournals.org